WHAT IS CLAIMED IS:

1. A perpendicular magnetic recording medium having a perpendicular recording layer on a substrate via a soft magnetic underlayer, wherein said soft magnetic underlayer comprises:

a first amorphous soft magnetic layer;

a second amorphous soft magnetic layer;

a non-magnetic layer which is formed between said first amorphous soft magnetic layer and said second amorphous soft magnetic layer; and

an antiferromagnetic layer which applies an exchange bias field to said first amorphous soft magnetic layer, and

said first amorphous soft magnetic layer and said second amorphous soft magnetic layer are antiferromagnetically coupled.

2. A perpendicular magnetic recording medium according to Claim 1, wherein said soft magnetic underlayer has a ferromagnetic layer between said first amorphous soft magnetic layer and said antiferromagnetic layer.

3. A perpendicular magnetic recording medium according to Claim 1, further comprising:

a first ferromagnetic layer, between said first amorphous soft magnetic layer and said non-magnetic layer; and

a second ferromagnetic layer, between said second

amorphous soft magnetic layer and said non-magnetic layer.

4. A perpendicular magnetic recording medium according to Claim 1, wherein the thickness of said first amorphous soft magnetic layer is equal to the thickness of said second amorphous soft magnetic layer.

5. A perpendicular magnetic recording medium having a perpendicular recording layer on a substrate via a soft magnetic underlayer, wherein said soft magnetic underlayer comprises:

a first amorphous soft magnetic layer;

a second amorphous soft magnetic layer;

a first non-magnetic layer which is formed between said first amorphous soft magnetic layer and said second amorphous soft magnetic layer;

a third amorphous soft magnetic layer;

a second non-magnetic layer which is formed between said second amorphous soft magnetic layer and said third amorphous soft magnetic layer; and

an antiferromagnetic layer which applies an exchange bias field to said first amorphous soft magnetic layer,

said first amorphous soft magnetic layer and said second amorphous soft magnetic layer are antiferromagnetically coupled, and

said second amorphous soft magnetic layer and said third amorphous soft magnetic layer are antiferromagnetically coupled.

6. A perpendicular magnetic recording medium according to Claim 5, wherein the thickness of said second amorphous soft magnetic layer is equal to the sum of the thickness of said first amorphous soft magnetic layer and the thickness of said third amorphous soft magnetic layer.

7. A perpendicular magnetic recording medium having a perpendicular recording layer on a disk substrate via a soft magnetic underlayer, wherein a magnetization curve of said soft magnetic underlayer measured by applying a magnetic filed to said disk substrate in a radial direction is step-shaped with a magnetization level which is stable in an arbitrary magnetic field range including a zero magnetic field, and

an absolute of a center value of a switching field from saturation magnetization on a negative magnetic field side to said magnetization level is different from an absolute of a center value of a switching field from the saturation magnetization on a positive magnetic field side to the magnetization level.

8. A magnetic storage apparatus comprising:

a perpendicular magnetic recording medium having a perpendicular recording layer on a substrate via a soft magnetic underlayer;

a driving section which drives said perpendicular magnetic recording medium in a recording direction;

a magnetic head having a recording section and a reproducing section;

a unit which relatively moves said magnetic head to said perpendicular magnetic recording medium; and

a recording/reproducing processing unit which inputs a signal from said magnetic head and reproduces an output signal from said magnetic head,

wherein said soft magnetic underlayer of said perpendicular magnetic recording medium comprises:

a first amorphous soft magnetic layer;

a second amorphous soft magnetic layer;

a non-magnetic layer which is formed between said first amorphous soft magnetic layer and said second amorphous soft magnetic layer; and

an antiferromagnetic layer which applies an exchange bias field to said first amorphous soft magnetic layer,

said first amorphous soft magnetic layer and said second amorphous soft magnetic layer are antiferromagnetically coupled,

said recording section of said magnetic head comprises a single-pole-type head, and

said reproducing section of said magnetic head comprises a high-sensitive element using a magnetoresistive effect or tunneling magnetoresistive effect.

9. A magnetic storage apparatus comprising:

a perpendicular magnetic recording medium having a perpendicular recording layer on a substrate via a soft

magnetic underlayer;

a driving section which drives said perpendicular magnetic recording medium in a recording direction;

a magnetic head having a recording section and a reproducing section;

a unit which relatively moves said magnetic head to said perpendicular magnetic recording medium; and

a recording/reproducing processing unit which inputs a signal from said magnetic head and reproduces an output signal from said magnetic head,

wherein said soft magnetic underlayer of said perpendicular magnetic recording medium comprises:

a first amorphous soft magnetic layer;

a second amorphous soft magnetic layer;

a (first) non-magnetic layer which is formed between said first amorphous soft magnetic layer and said second amorphous soft magnetic layer;

a third amorphous soft magnetic layer;

a (second) non-magnetic layer which is formed between said second amorphous soft magnetic layer and said third amorphous soft magnetic layer; and

an antiferromagnetic layer which applies an exchange bias magnetic field to said first amorphous soft magnetic layer,

said first amorphous soft magnetic layer and said second amorphous soft magnetic layer are antiferromagnetically coupled,

said second amorphous soft magnetic layer and said

third amorphous soft magnetic layer are antiferromagnetically coupled,

said recording section of said magnetic head comprises a single-pole-type head, and

said reproducing section of said magnetic head comprises a high-sensitive element using a magnetoresistive effect or tunneling magnetoresistive effect.

10. A perpendicular magnetic recording medium having a perpendicular recording layer on a disk substrate via a soft magnetic underlayer, wherein said soft magnetic underlayer comprises:

a first amorphous soft magnetic layer;

a second amorphous soft magnetic layer;

a non-magnetic layer which is formed between said first amorphous soft magnetic layer and said second amorphous soft magnetic layer; and

an antiferromagnetic layer which applies an exchange bias field to said first amorphous soft magnetic layer,

said antiferromagnetic layer contains a disordered alloy mainly composed of Fe and Mn,

the direction of said exchange bias field is substantially in parallel with said radial direction of said disk substrate, and

said first amorphous soft magnetic layer and said second amorphous soft magnetic layer are antiferromagnetically coupled.

11. A perpendicular magnetic recording medium according to Claim 10, wherein said antiferromagnetic layer is formed on a soft magnetic layer having a face-centered cubic structure.

12. A perpendicular magnetic recording medium according to Claim 10, wherein said soft magnetic underlayer has a ferromagnetic layer between said first amorphous soft magnetic layer and said antiferromagnetic layer,

said ferromagnetic layer is a body-centered cubic alloy mainly composed of Co and Fe.

13. A manufacturing process of a perpendicular magnetic recording medium comprising the steps of:

forming an antiferromagnetic layer on a disk substrate;

forming a first amorphous soft magnetic layer on said antiferromagnetic layer;

forming a second amorphous soft magnetic layer on said first amorphous soft magnetic layer via a non-magnetic layer;

heating said disk substrate approximately to the blocking temperature of said antiferromagnetic layer; and

cooling said disk substrate to 60°C or less,

wherein said step of cooling said disk substrate is performed while applying a magnetic field in the radial direction of said disk substrate.

14. A manufacturing process of a perpendicular

magnetic recording medium comprising the steps of:

forming an antiferromagnetic layer on a disk substrate;

forming a ferromagnetic layer on said antiferromagnetic layer;

forming a first amorphous soft magnetic layer on said ferromagnetic layer;

forming a second amorphous soft magnetic layer on said first amorphous soft magnetic layer via a non-magnetic layer;

heating said disk substrate approximately to the blocking temperature of said antiferromagnetic layer; and

cooling said disk substrate to 60°C or less,

wherein said step of cooling said disk substrate is performed while applying a magnetic field in the radial direction of said disk substrate.

15. A manufacturing process of a perpendicular magnetic recording medium comprising the steps of:

forming an antiferromagnetic layer mainly composed of Fe and Mn on said disk substrate;

forming a first amorphous soft magnetic layer on said antiferromagnetic layer;

forming a second amorphous soft magnetic layer on said first amorphous soft magnetic layer via a non-magnetic layer; and

cooling said disk substrate to 60°C or less in an atmosphere containing He or H,

wherein all of the entire said steps are performed

while applying a magnetic field in the radial direction of said disk substrate, and all polarities of magnetic field are the same.

16. A manufacturing process of a perpendicular magnetic recording medium comprising the steps of:

forming an antiferromagnetic layer mainly composed of Fe and Mn on said disk substrate;

forming a ferromagnetic layer on said antiferromagnetic layer;

forming a first amorphous soft magnetic layer on said ferromagnetic layer;

forming a second amorphous soft magnetic layer on said first amorphous soft magnetic layer via a non-magnetic layer; and

cooling said disk substrate to 60°C or less in an atmosphere containing He or H, and

wherein all of the said steps are performed while applying a magnetic field in the radial direction of said disk substrate, and all polarities of magnetic field are the same.